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Land-use reconstruction by biomarker analyses in Holocene lake sediments

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In the present study we evaluated the applicability of biomarker analyses in lake sediments for reconstruction of anthropogenic landscape modifications during the Holocene. For vegetation and land-use reconstructions, frequently, pollen has been analysed in lake sediments. However, pollen spectra do not assuredly reflect the vegetation of the catchment area (long distance transport). In contrast, biomarkers of terrestrial plants are transported into lakes within the sediments of the catchment area (or by litter of lakeshore vegetation). Furthermore, biomarkers can deliver information about ancient land use such as animal husbandry.
However, there is some evidence that biomarkers can be translocated in sediments and soils. A translocation could cause that biomarker data would not fit to pollen data and other data of the sediment layers.
As a first step, we analysed n-alkanes (vegetation) and correlated the data with pollen spectra to check if a translocation of biomarkers occurred in soils or sediments. As a second step, we investigated the potential of faecal steroids incl. bile acids. Samples of sediment cores of two maar lakes in the Eifel region (Germany) were used as an example for lake sediments because a number of data existed from previous analyses of these cores (ELSA project). Five core sections of Lake Holzmaar and two core sections of Lake Ulmener Maar were sampled. In core sections covering the Neolithic and younger times, patterns of n-alkanes correlated with pollen data. We concluded that biomarkers were not translocated (and pollen mainly originated from the catchement area).
In Lake Holzmaar, parts of the core that show characteristics of dense forest in the catchment area had relatively low amounts of faecal steroids and the steroid patterns indicated the presence of several different animals. In parts of the core that show characteristics for anthropogenic landscape opening and land use, faecal steroids showed the presence of animal husbandry. The pollen spectra and n-alkane patterns in both core sections in Lake Ulmener Maar indicated forest cover. However, steroid concentration indicated animal husbandry in the upper core section (Rössen Culture/Michelsberg Culture). Thus, the biomarker data were coherent with the assumption that land use during this time was wood pasturing.
Using the example of maar lakes, this study showed that biomarkers have a high potential for the reconstruction of vegetation history in in lake sediments where pollen analyses failed. In addition, the investigation of animal husbandry by analyses of faecal steroids delivers information that cannot be obtained by pollen analyses or by other classically analysed parameters in lake sediments.